Octupole Vibrations and Signature Splitting in Even Mass Hg Superdeformed Bands

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The possibility that the lowest excited SD bands in even mass mercury isotopes (^{190,192,194}Hg) are based on octupole vibrations has been discussed previously[1, 2] in terms of the moments of inertia and decay properties. In this present work[3] we have investigated the signature splitting of excited SD bands in ^{194}Hg isotopes. The signature splitting depends on the mixing with other states, e.g. other K components of the octupole vibration. Since the K=0 octupole vibration contains only the α=1 sequence, there will be an additional Coriolis mixing among α=1 states. Odd spin (α=1) bands which lie below the K=0 band will therefore be favored with respect to the corresponding even spin α=0 band. Thus if the octupole interpretation is valid, and in the absence of other effects (band-crossings etc), one may expect the odd spin band to be favored in a signature-split pair of bands.

The signature splitting (difference in the Routhian energies) for the ^{194}Hg excited SD bands is shown in Fig. 1. The experimental data (circles) exhibits an initial splitting which is consistent with these bands being based on octupole vibrational states. At higher frequencies the α=0 band (band 2) gains in energy relative to band 3 at the highest frequencies. In other words, after an initial 'octupole-like' splitting, there appears to be a trend towards 'signature inversion', whereby the α=0 band is becoming favored relative to the α=1 band. For the three calculated cases in Fig. 1 the α=1 structure starts lower in energy but at higher frequencies the α=0 band becomes increasingly favored due to the mixing with close lying 2-quasiparticle states, e.g. $\pi[642]5/2 \otimes \pi[514]9/2$. The calculations are able to reproduce, in a quantitative manner, both the initial signature splitting observed in ^{194}Hg and the subsequent 'inversion' lending support to the presence of octupole effects in this nucleus.

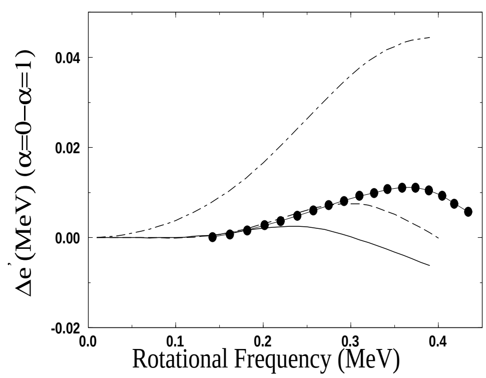

Fig. 1: The difference ($e'(\alpha$=0)-$e'(\alpha$=1)) for both the experimental (circles) and calculated ^{194}Hg band 2 and 3 Routhians. Three curves are shown for the calculated Routhians, each with the same octupole strength, f_3=1.05, but with differing pairing; (i) The solid line has the critical frequency for pairing $\hbar\omega_c$ = 0.5(0.3) MeV for neutrons(protons). (ii) The dashed line has $\hbar\omega_c$ = 0.5(0.5) MeV for neutrons(protons). (iii) The dot-dashed has constant pairing strength as a function of rotational frequency.

References

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